LBNE LAr Parameters Spreadsheet

Version 10.6 - 11/4/2011

Changes highlighted in RED

33 kton

Input value

Calculated

Reference Design, 800'

Quality	Meaning
***	Stable, well understood parameter
**	Reasonably well defined parameter
*	Rough estimate

Parameter	Value	Units	Quality	Req ID	Notes
Anode Plane Assembly (APA)					
Cathode Plane Assembly (CPA)					
Detector Module					
Cryostat module					
Electronics					
High Voltage					
Cryogenics					
Num recirculation pumps per cryostat	4		**		Provides redundancy during operation. None during initial purification
Recirculation pump flowrate (purity maintenance)	47,000	kg/hr	**		Maximum turn over rate chosen to be ~twice of ICARUS
	34	m^3/hr			
	148	gpm			
Recirculation pump flowrate - max	188,000	kg/hr			
	135	m^3/hr			
	592	gpm			
LAr volume turnover @ max flowrate	5.5	days			
Pump power - hydraulic	6.5	kW			Assumes 30m (60 psi) head pressure
Pump rated power - electric	12.6	kW	**		
Pump refrigeration load - max	50.5	kW			Assumes 30m (60 psi) head pressure, all pumps on
Insulation thickness	1	m	**		
Insulation thermal conductivity	0.0283	W/m-K	**		fiber reinforced polyurethane at Tavg = (Tconc+Targon)/2
Concrete temperature	278	K			Heated 5 K above freezing
Insulation heat loss	5.41	W/m^2			Q"=(k/L)*(dT)
Insulation heat loss	27.2	kW			
Piping and purification vessel heat load	2.0	kW	*		
LAr storage dewar heat load	2.0	kW	**		D-Zero LN2 & LAr dewars are 1.1 kW each
LN2 storage dewar heat load	2.0	kW	**		D-Zero LN2 & LAr dewars are 1.1 kW each
Purifier regeneration cool down load	30.0	kW	*		24 hour cool down
Refrigeration load - nominal, purity maintenance	66.0	kW			assumes filter regenerations every 2 days
Refrigeration load - max during initial purification	103.9	kW			
Num refrigeration plants	3		***		One operating per cryostat and one standby/supplemental
Refrigeration unit capacity - nominal	60	kW	**		From Arup concept report
Refrigeration turn up, turn down range	20	%	***		from manufacturer
Refrigeration unit capacity - maximum	72	kW			
Refrigeration plant capacity - max	216	kW			Both plants in operation
Refrigeration plant margin	8%				
Refrigeration plant power input	569	kW	**		Scaled from Arup 2010 concept report, 59 kW machine
Refrigeration plant heat output	142	kW	**		Scaled from Arup 2010 concept report, 59 kW machine
LAr Heat of vaporization	161.4	J/g	***		At ullage pressure, 0.98 bar absolute, REFPROP see cryo sheet.
LAr boil-off rate - nominal	1473	kg/hr			
LN2 storage dewar capacity	50	m^3	**		One dewar backs up entire refrigeration plant
LN2 Heat of vaporization	183	J/g	***		At 3 atm
LN2 density	0.7559	g/cm^3	***		At 3 atm
LN2 consumption rate - nominal	1.7	m^3/hr			Normal operation w electronics on
LN2 consumption rate - minimized non-operating	0.9	m^3/hr			
LN2 storage dewar backup time- both cryostats full	29	hrs			Based on minimal, non-operating load
Detector Depth					
Radioactive Background					
Veto System					
Veto Configuration					
Veto Counter					
Photon Detector					
DAQ					
Cavern & Pit					